Tuning the Resonance Frequency of Piezoelectric MEMS Microphones by Sizing Acoustic Ports

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Abstract

The acoustic port of a MEMS microphone package acts not only to transmit sound pressure to the MEMS transducers, but also to partially block environmental contaminations such as water and dust. Capacitive MEMS microphones rely on a small capacitive sensing gap, making them vulnerable to water and dust. Therefore, the microphone acoustic port is normally restricted to a small size (typically 0.25 mm in diameter). Piezoelectric MEMS microphones, however, are naturally immune to water and dust, thanks to the absence of the small sensing gap. This attribute gives more flexibility in microphone package design. Taking advantage of this flexibility, this work demonstrates the tunability of the resonance frequency of piezoelectric MEMS microphones by adjusting the acoustic port size in the microphone package. The piezoelectric MEMS microphones in this work use aluminum nitride as the piezoelectric material, and they are packaged with JFETs in common source amplifier circuits to buffer the signal. They are packaged in a 4.72 mm x 3.76 mm x 1.5 mm package. By adjusting the diameter of the acoustic ports from 0.35 mm to 0.75 mm, the resonance frequency of these microphones can be tuned by 1.4 kHz. A lumped parameter model of the microphone package has been developed and it shows a reasonable agreement with the test results.